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ABSTRACT

Reported are research findings that (1) illustrate the importance of primary spatial orientation for children's and adults' use of symbolic spatial skills and (2) indicate the importance of the distinction between primary and secondary spatial orientation. At least two major ways exist in which humans gather and use spatial information. The conceptually and developmentally primary manner of use guides immediate orientation and action in space. Secondary uses of spatial information include symbolic representation and various aspects of spatial thought (for example, drawing or reading maps, mental rotation, perspective problems). The distinction between primary and secondary uses of space has not been consistently pursued, and the ongoing role of primary orientation in the post-infancy years for all spatial tasks has been overlooked. Research findings indicate that primary orientation to immediate space affects the ability to use spatial symbols and to establish in a secondary way their correspondence with specific spatial information. The importance of the contrast between primary and secondary spatial systems can be seen also in differing modes by which spatial information is learned. Some areas needing additional study are specified and a promising direction for further research is described. (RH)

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BEYOND EGOCENTRISM: DEVELOPING SYMBOLIC USES OF SPATIAL INFORMATION

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Beyond Egocentrism: Developing Symbolic Uses of Spatial Information

It has become clear that laboratory research, especially that using symbolic materials, has not demonstrated the full spatial competence of young children. This is true if we consider the infant's ability to locate objects in rather simple hiding tasks or the ability of school children to reason about more abstract spatial transformations. Research on spatial development has often ignored the functional uses of space and the importance of primary, direct orientation to space. Children's spatial performance, whether "errors" or correct responses, must be viewed in a larger context as reflecting processes of using space, rather than as an index solely of the general competence or stored knowledge of the child (Liben, 1981; Presson & Somerville, in press).

Many researchers have changed the focus of their work away from the lab setting and abstract spatial processes and towards more practical tasks in real world settings (Herman & Siegel, 1978; Siegel, 1981; Wellman & Somerville, in press). This has been an important development, and we are gaining great insight into the practical spatial competence of children. However, there have not been similar systematic attempts to study directly the nature of symbolic spatial abilities. To establish a more complete understanding of human spatial abilities and their development, it is necessary (1) to look at the ways in which humans use spatial information and (2) to consider how our more abstract reasoning abilities and knowledge is coordinated with our more immediate orientation to space.

There are at least two major ways in which humans gather and use spatial information (Presson & Somerville, in press). The first, conceptually and developmentally primary, guides our immediate orientation and action in space. Given the requirements of a mobile organism, we have evolved a variety of primary perceptual mechanisms to allow us to know where we are, to be oriented

to be ready to act in space, and to determine what to expect as we move (Howard & Templeton, 1966).

Primary orientation focuses attention to aspects of the surrounding spatial world, to which we will be prepared to act directly. The extent of that information implicitly defines our sense of near space, which for practical purposes forms the "working spatial memory" for orientation and action (Howard & Templeton, 1966). The processes involved in registering the immediate surrounds into near space via the primary spatial system are relatively automatic in adults and are in part guided by expectations and higher order units ("frames") that structure the amount of and types of features to which we typically first attend (Minsky, 1975; Salmaso, Baroni, Job, & Peron, 1983). As such, our orientation to the spatial field acts as a "backdrop" against which other spatial behaviors (including symbol use) are interpreted. This gives the immediate spatial field a special status since it serves as the context to define the meaning of our spatial responses. The importance fo the larger context as a frame of reference for interpreting specific local information has been shown repeatedly in perceptual contexts (e.g. Navon, 1977; Palmer, 1980; Rock, 1973) and is also suggested by Gibson's (1966) more general view of the importance of the embedding context in perceiving invariance in the world. The importance of specifically spatial frames of reference has been shown in several contexts (Acredolo, 1976; Pick & Lockman, 1981).

Humans also use spatial information in a <u>secondary</u> way to deal with information to which we are not directly oriented. Secondary uses of spatial information include symbolic representation and various aspects of spatial thought (e.g., drawing or reading maps, mental rotation, perspective problems). These secondary uses of space develop after infancy, but do not

replace the ongoing importance of primary spatial skills. As we will see, the secondary, symbolic skills must be coordinated with the primary ones.

To illustrate the distinction between primary and secondary uses of spatial information, consider an animal traversing a terrain (of relatively small or large scale). As the animal moves, its relation to objects in the environment changes. To be well adapted, mobile organisms must keep track of where they are (e.g., Krebs, 1978; Menzel, 1973; O'Keefe & Nadel, 1978; Olton, 1977). Doing so, while maintaining position constancy, requires the representation of information about space. Later, when the animal returns to that space, it will show a benefit from prior encounters. In this case, the nature of the practical gain constitutes evidence of some representation of the spatial information. (E.g, the animal might remember and locate a food source or a hiding place, or use a more efficient route through the space.)

If the animal crossing the terrain is an adult human, there is a second sense in which he or she might use the represented information. The adult may, for example, draw a map that symbolically represents the space. The creation of such external representation provides much stronger evidence that some form of stored spatial information exists. At the same time it requires the capacity to use graphic, verbal or other symbols in specific ways (c.f., Piaget & Inhelder, 1967; Siegel & White, 1975; Werner & Kaplan, 1973). This is a major developmental shift in spatial abilities, but the shift consists of changes in the ways in which stored information can be used, rather than changes in the nature of the coding.

The basic distinction between two ways of using spatial information -- one more perceptual and direct, and the second more indirect and conceptual -- is not new (e.g., Cassirer, 1955; Hart & Moore, 1973; Piaget & Inhelder, 1967; Werner & Kaplan, 1963). Whenever theorists have considered taxonomies of spatial behavior, some similar distinction has been drawn. There is even

evidence that these two uses of spatial information may be mediated in distinct brain areas (O'Keefe & Nadel, 1978; Potegal, 1982).

However, although the distinction between primary and secondary uses of space has been made, it has not been consistently pursued, and the ongoing role of primary orientation in all spatial tasks has been overlooked in the post-infancy years. The growing evidence that children do know more than traditional work had shown has led researchers to switch the focus of work on spatial development away from the laboratory, with more table-top scale models and a dependence on symbolic skills, toward more practical tasks in real-world settings (e.g., Acredolo, 1981; Herman & Siegel, 1978; Siegel, et al., 1983). Within the current framework, the major adjustment of these later studies has been to reduce the symbolic needs and thus remove the conflict between the primary and secondary uses of space. While these studies demonstrate the practicial competences of the child, I want to suggest that we need also to consider the mechanisms that underlie secondary uses of spatial information, and examine how our biologically more important primary orientation to immediate space creates difficulties in using spatial symbols.

This morning I want to highlight three examples from my research on the use of secondary spatial skills to illustrate the importance of primary spatial orientation on how children and adults use symbolic spatial skills, and the importance of the distinction between primary and secondary spatial orientation.

The first example comes from my work in spatial reasoning, much of which was done initially in collaboration with Jonellen Huttenlocher (Huttenlocher & Presson, 1973,1979; Presson, 1980, 1982a). We looked in particular at how children solve the classic perspective, or three mountain, problem, in which a child must anticipate how an array would be relative to a viewer in some

different vantage point. Piaget & Inhelder, as well as many other researchers since, have shown that the perspective problem is quite difficult in some forms until at least the middle elementary school years, and children make a very specific error. When they pick pictures or models, they respond as if the observer would always see just what the child currently sees. Piaget & Inhelder labelled these errors "egocentric," and argued that the young child did not understand that spatial relations (left-right; fore-behind) were relative to the position of the observer.

However, in our work the difficulty of viewer-rotation task, and the systematic egocentric errors occurs only in certain procedures when the task demands created a conflict between the primary and secondary information. We contrasted different question types for viewer-rotation tasks (as well as for the logically equivalent array rotation task). With the standard appearance questions, which deal with how the entire array would look to the viewer after the move, we found the standard pattern: viewer rotation was difficult and a preponderence of the errors were egocentric. However, when a different question procedure was used, a very dramatic shift in the task difficulty occured (see Figure 1).

When we probed the individual element's relation to the observer using item questions, the viewer-rotation task was very easy and children did not tend to make systematic egocentric errors. These item questions ask which of the array elements is in specified relation to the observer (E.g, What item in the array would be in front of (or on the side or back of) the viewer?). Note that the items questions require all the logical information about how the observer relates to the array. Since items questions are easy, these children know the logical information about how the array spatially is related to the observer. Yet, they fail to use that information as required in answering the appearance questions. Why not? The answer can be found in the way in which

children focus on the immediate spatial field. They know how any transformation will changes in space, but are limited in showing the information in a secondary way.

In both my own subsequent work (Presson 1980) and the related work of Liben (Liben & Belknap, 1981), children have been shown to have difficulty in using the pictures or models to serve as a flexible spatial symbol. The immediate spatial field defines the meaning of the symbols in a very naive realistic manner. Although children do know how a spatial transformation would alter the immediate surrounds (locate the observer in a new position or rotate the array), they choose the realistic (or egocentric) alternative because that "best" (most directly) shows that new state of affairs (see figure 2). The egocentric error depends more on using the spatial field realistically than on maintaining the egocentric relation of the array to self. To demonstrate this, I (Presson, 1980) presented a model room that showed the features of the immediate spatial field, but which was rotated on each trial to show how the room would appear to the viewer. When children had the model room available as an alternate frame of reference, systematic egocentricity was reduced or eliminated.

The most notable way in which the immmediate spatial field affects spatial responding can be seen with pictures, models, or other symbols. However, the problem can be seen as more specifically as making a response that conflicts with the immediate orientation to space. If the perspective problems are probed with a third type of question, <u>position</u> questions, then no symbols are used, but children make the systematic errors. Position questions ask <u>where</u> a specific array element would be after the transformation. Here, the first inclination of subjects is to directly indicate the position of the named array element, which is of course unchanged, and the persepctive task is difficult (Hardwick et al, 1976; Presson, 1982a). To indicate the correct

relative position, subjects must use an abstract frame of reference to formulate the response, rather than the immediate spatial field.

The importance of orientation to the immediate space can also be seen seen in an altered form of the perspective procedure, if the subject actually moves to the new vantage point relative to a covered array (Huttenlocher & Presson, 1973; Shantz & Watson, 1971). Although no new logical information is provided, the task becomes quite easy, without systematic egocentric errors. This is because the alignment of the responses to the immediate spatial field has changed, so that the correct alternative directly shows the actual state of affairs (see Figure 2b).

The major difficulty in coordinating the logical information with the immediate spatial field occurs during childhood. However, it is important to note that the importance of the primary orientation to space and its effect on spatial reasoning problems does not disappear. I have shown (Presson, 1982a) that adults show the same patterns of relative task difficulty for the different question types as we previously found for children. Of course, adults typically do not make egocentric errors. However, they do report an initial tendency to make the realistic response, which they recognize is not sufficient.

DEVELOPMENT OF MAP SYMBOLS AND SPATIAL CORRESPONDENCE.

This basic difficulty in coordinating secondary and primary spatial correspondences can also be seen in a second set of studies, looking at children's using the prototypic spatial symbols -- maps -- in target location tasks.

The use of maps as spatial symbols has several components. First, the knowledge that the map is intended to represent some spatial information is necessary, and the individual symbols on the map must show identity

correspondence. Second, the configuration of map elements must also perserve configural relations of the actual landmarks in space.

It is clear that preschoolers can establish these correspondences in a simple map if the map is aligned with the space (Bluestein & Acredolo, 1979; Presson 1982b,1983). However, they have some difficulty if the map orientation conflicts with the immediate space. This conflict is like the realistic errors that are shown in the perspective task with appearance questions. They appear to use the map marker as a direct index of the target location, when not allowed to turn it. If they are given the opportunity to rotate the map to bring it into alignment, they do so (Presson, 1983).

If the map is aligned with the space that it represents, then it is a very direct, primary correspondence that is needed to extract information from the map and locate a target. Even rather young children can do this (Bluestein & Acredolo, 1979; Presson 1982b, 1983). However, if the map is not aligned initially with the space, then the orientation correspondence must be established by either physically or mentally turn the map. If the map is presented to a child in a nonaligned orientation, then its use as a spatial symbol is complicated by the immediate spatial field, which serves as the direct, but incorrect frame of reference to interpret the symbol.

If the map symbol is read at a distance from the space that it represents, then there would be less conflict with the immediate spatial field, and children should make fewer realistic errors. This is in fact what is found (Bluestein & Acredolo, 1979; Presson, 1982, 1983). In fact, the distance from the space roughly determines whether such errors occur at all. When maps are read at a greater distance from the hiding space, then kindergartners show no tendency to make realistic errors (Presson, 1982). However, if the maps are read immediately adjacent to the hiding area, but not in sight young children make many fewer such errors than if the maps are in the space, but still do

relate the maps to the space on some occasions (Bluestein & Acredolo, 1979; Presson, 1983). Thus, one's primary orientation to space (one's near space) is likely to extend beyond the immediate visual field.

Just as I had shown in the spatial reasoning studies, the importance of the immediate spatial field in using maps does not disappear with development. Levine (Levine, 1982; Levine et al, 1982) has shown that when adults attempt to use a map to locate a target, the orientation of the map to space is very important. If the map is oriented so that there is a direct correspondence between the map and the space, adults use them effectively. However, if the map is misaligned with the space, then adults are often misled and make quite gross errors. Adults tend to treat the map realistically, very much as do children.

USING PRIMARY AND SECONDARY INPUT TO BUILD SPATIAL KNOWLEDGE

Thus, primary orientation to immediate space affects the ability to use spatial symbols and establish their correspondence to specific spatial information in a secondary way, as seen in the reasoning and map tasks. We can also see the importance of this contrast between primary and secondary spatial systems in contrasting modes of learning spatial information. To obtain spatial knowledge, humans can learn new information from either direct, primary orientation to the information (especially through visual orientation and locomotion), or through symbolic, indirect encounters (e.g, maps). I want to raise the question of whether there are functional differences in these two modes of gathering information about space.

Little is known about children's ability to gather systematic array information from map representations, which in part reflects the importance of primary orientation in establishing such information for children. The ability to use map information to learn about spatial relations the immediate world

has been studied in adults. Recently, Marvin Levine at Stony Brook has demonstrated that the information obtained from a map is very orientation specific, which limits people's ability to use that information flexibly. This finding was similar to that reported for maps, in that they are difficult to interpret if misaligned with the space. Levine argued that spatial representations more generally are also map like and should typically show orientation effects. Given that as mobile organisms we have evolved our primary spatial senses to build flexible knowledge bases, I wondered whether this would be true for information obtained when directly oriented to the space, especially given recent evidence that spatial knowledge learned through navigation (with both visual and nonvisual information) is more flexible in spatial judgments than that learned only through maps (Evans & Pezdek, 1980; Thorndyke & Hayes-Roth, 1982).

Along with a graduate student Mark Hazelrigg, I have begun to pursue this question of whether primary and secondary spatial systems result in different types of information. We have first replicated Levine's finding with visually experienced maps and have shown that the alignment of the map display has a dramatic effect on the ease of making spatial judgments. We used Levine's basic procedure with simple routes as shown in figure 3. The routes were four point routes with three path segments. Subjects viewed a map of the route for 30 sec and then were blindfolded, wheeled to a point on the route, and asked to make a spatial judgment. The critical distinction is their orientation when making that judgment was aligned or contra-aligned with the map information, as shown in the figure. For example, given the simple four point route shown (see Figure 4), two subjects are placed at point 3, told that point 4 is directly ahead of them, and then asked to indicate where point 1 would be. The subject on the right was shown the map information in an orientation aligned with the judgment that they are asked to make, while for

the subject on the left the map is contraaligned with their orientation on the route. For similar judgments, subjects (n=12, 4 judgments of each type) were much more accurate when the map information was aligned with their orientation, than when the maps were contra-aligned (see Figure 5). This is quite clear both for overall mean error and for the percent of judgments that are larger than expected by chance (90 degrees).

That finding replicates Levine's data for getting spatial information through symbolic means. There was a striking contrast, however, when subjects were presented the information via primary spatial orientation. We have had subjects learn the route information through two primary modes, looking directly at the route laid out on the floor and by locomoting the route while blindfolded. Today I will only talk about the LOOK condition, which provides the clearest contrast between primary and secondary input of information. In this "LOOK" condition, subjects viewed the route from one vantage point for 30 sec. Thus, with the minor exceptions of a difference in scale and a slight difference in perspective, the route information that was provided these subjects was equivalent to that provided to subjects in the map condition. The only difference was that the LOOK group viewed the route directly while oriented to it, and the MAP group viewed the route indirectly in the map. As you can see in the overhead, there was an impressive (and even surprising) difference between the MAP and LOOK groups.

In the LOOK group, when the route was viewed directly, there was basically no difference in making judgments while aligned or contraaligned with the viewing experience. Thus, spatial memory in the two instances results in very important functional differences in the ability to use the information for later orientation. When the information is gathered from primary spatial orientation, it can be used in a more flexible way than when it is obtained in secondary, symbolic form. A similar finding obtained when

the routes were learned by locomoting the routes three times while blindfolded.

The flexibility of the spatial representations when they are build via primary spatial orientation is not surprising if one considers the important functional requirements of our primary spatial abilities. However, when we consider the nature of spatial competence and its development it is important to recognize the contrast and interplay between the primary and secondary modes of gathering and using spatial information.

My work has shown the importance, in a variety of contexts, of the distinction between primary and secondary uses of spatial information. This is true for understanding the development of spatial symbol use, as well as for understanding the functional importance of primary, direct experience as contrasted with indirect, symbolic experience when building spatial knowledge for later use. Although it is clear that the primary uses of space will typically show greater competence in spatial tasks, especially with younger children, I want to raise the challenge (or suggestion) to my colleagues to return to the question of how secondary, symbolic uses of space develop.

The issues that remain unexplored concern how children develop the ability to use the spatial symbols in more flexible ways, to begin to free them from the influence of the immediate spatial field. Studies of early perspective skills have consistently shown that young children have greater knowledge than typical procedures would suggest (e.g., Masangkay et al., 1974). However, these procedures have focused on a reduction in secondary, symbolic task demands, rather than a systematic understanding of how the symbols themselves are used.

In both using maps to locate targets in a known space and using models or pictures to display relational information, the major task (and problem) is to establish an abstract correspondence or "as if" equivalence between the symbol

and the immediate space or imagined state of affairs. Children do know the logical relations of the array to the observer, and can name them (as in item questions), yet fail when they attempt to convey the information in a spatial symbol or other response that is influenced by the immediate surroundings.

The ways in which children coordinate primary and secondary systems to use spatial symbols is not well understood and requires additional study. One promising direction may be suggested in the recent work of Howard Gardner's group (Gardner, 1983; Davis & Fucigna, 1983). They had children draw maps of a landscape over several years in a longitudinal study. Early maps were not different from drawings in that they contain specific perceptual detail. Children later learn abstraction rules and begin to separate a map from a drawing. In more mature maps the appearance of individual items was no longer central. Children used abstract symbols (e.g., treating all trees alike) and aerial views. To the young child, the map is likely to be equivalent to a drawing in that they both have a very direct, immediate relation to what they represent. It is only at ages 8-9 that a spatial symbol can be abstracted and disembedded from the immediate spatial field.

The developmental course described in this preliminary work is very much consistent with the proposed importance of primary spatial orientation in the use of spatial symbols. The first use of spatial symbols is concretely tied to a very direct relation to the immediate spatial surrounds. Secondary uses of space form an integral part of overall spatial development, and the ability to coordinate the more abstract use of symbols with the ongoing importance of primary spatial orientation to the immediate surrounds is an important cognitive developmental process. Over the past decade we have demonstrated the practical spatial competence of young children, the challenge that remains is to turn our attention to the basic processes that underlie that coordination.

References

Acredolo, L. P. Frames of reference used by children for orientation in unfamiliar spaces. In G. Moore & Golledge (Eds.), Environmental Knowing, Stroudsberg, PA. Dawden, Hutchinson, & Ross, 1976.

Acredolo, L. P. Small- and large- scale spatial concepts in infancy and childhood. In L. Liben, A. Patterson, & N. Newcombe (Eds.) Spatial Representation and behavior across the lifespan. New York: Academic Press, 1981.

Bluestein, N. & Acredolo, L. Developmental changes in map-reading skills. Child Development, 1979, 50, 691-697.

Cassirer, E. The philosophy of symbolic forms. Vol. 2, Mythical thought. New Haven: Yale Univ. Press, 1955.

Davis, M. & Fucigna, C. From drawing to mapping: Channeling symbolic activity. Symposium paper presented at SRCD, 1983.

Evans, G. & Pezdek, K. Cognitive mapping: Knowledge of real-world distance and location information. Journal of Experimental Psychology: Human Learning and Memory, 1980, 6, 13-24.

Gardner, H. The nature of symbolic skills. Symposium paper presented at SRCD, April 1983.

Garling, T. Environmental orientation during locomotion. Stockholm: Swedish Council for Building Research, 1980.

Gibson, J.J. The senses considered as perceptual systems. Boston: Houghton Mifflin, 1966.

Hardwick, D., McIntyre, C., & Pick, H. The content and manipulation of cognitive maps in children and adults. Monographs of the Society for Research in Child Development, 1976, 41, (3, serial No. 166).

Hart, R. & Moore, G. The development of spatial cognition: A review. In R.

Downs & D. Stea (Eds.) Image and environment: Cognitive mapping and spatial behavior. Chicago: Aldine, 1973.

Herman, J. F. & Siegel, A. The development of cognitive mapping of the large scale environment. Journal of Experimental Child Psychology, 1978, 26, 389-406.

Howard, I. & Templeton, W. Human spatial orientation. New York, Wiley, 1966.

Huttenlocher, J. & Presson, C. Mental rotation and the perspective problem. Cognitive Psychology, 1973, 4, 279-299.

Huttenlocher, J. & Presson, C. The coding and transformation of spatial information. Cognitive Psychology, 1979, 11, 375-394.

Krebs, J. Optimal foraging: Decision rules for predators. In J. Krebs & N. Davies (Eds.) Behavioral ecology: An evolutionary approach. London: Blackwell, 1978.

Levine, M. YOU-ARE-HERE maps: Psychological considerations. Environment and Behavior, 1982, 221-237.

Levine, M., Jankovic, I. & Palij, M. Principles of spatial problem solving. Journal of Experimental Psychology: General, 1982, 111, 157-175.

Liben, L. Spatial representation and behavior: Multiple perspectives. In L. Liben, A. Patterson, & N. Newcombe (Eds.) Spatial Representation and behavior across the lifespan. New York: Academic Press, 1981.

Liben, L. Children's large-scale spatial cognition: Is the measure the message? In R. Cohen (Ed.) New directions for child development: Children's conceptions of spatial relationships. San Francisco: Jossey-Bass, 1982.

Liben, L. & Belknap, B. Intellectual realism: Implications for investigations of perspective taking in young children. Child Development, 1981, 52, 921-924.

Masangkay, Z., McCluskey, K., McIntyre, C., Sims-Knight, J., Vaughn, B., &

Flavell, J. The early development of inferences about the visual percepts of others. Child Development, 1974, 45, 357-366.

Menzel, E. Chimpanzee spatial memory organization. Science, 1973, 192, 943-945.

Minsky, M. A framework for representing knowledge. In P. Winston (Ed.), The psychology of computer vision. New York: McGraw-Hill, 1975.

Navon, D. Forest before trees: The precedence of global features in visual perception. Cognitive Psychology, 1977, 9, 353-383.

O'Keefe, J. & Nadel, L. The hippocampus as cognitive map. Oxford: Claredon Press, 1978.

Olton, D. Spatial memory. Scientific American, 1977, 236, 82-98.

Palmer, S. What makes triangles point: Local and global effects in configurations of ambiguous triangles. Cognitive Psychology, 1980, 12, 285-305.

Piaget, J. & Inhelder, B. The child's conception of space. New York: Norton, 1967.

Pick, H. & Lockman, J. From frames of reference to spatial representation. In L. Liben, A. Patterson, & N. Newcombe (Eds.) Spatial Representation and behavior across the lifespan. New York: Academic Press, 1981.

Potegal, M. Vestibular and neostriatal contributions to spatial orientation. In M. Potegal (Ed.) Spatial abilities: Development and physiological foundations. New York: Academic Press, 1982.

Presson, C. Spatial egocentrism and the effect of an alternate frame of reference. Journal of Experimental Child Psychology, 1980, 29, 391-402.

Presson, C. Strategies in spatial reasoning. Journal of Experimental Psychology: Learning, Memory, and Cognition, 1982, 8, 243-251.(a)

Presson, C. The development of map-reading skills. Child Development, 1982, 53,

196-199.(b)

Presson, C. Using landmarks in maps. Manuscript under review, 1983.

Presson, C. & Somerville, S. Beyond egocentrism: A new look at the beginnings of spatial representation. In H. Wellman (Ed.) The development of children's spatial search. Hillsdale, N. J.: Erlbaum, in press.

Rock, I. Orientation and form. New York: Academic Press, 1973.

Salmaso, P., Baroni, M., Job, R., Peron, E. Schematic information, attention, and memory for places. Journal of Experimental Psychology: Learning, Memory, and Cognition, 1983, 9, 263-268.

Shantz, C. & Watson, J. Spatial abilities and spatial egocentrism in the young child. Child Development, 1971, 42, 171-181.

Siegel, A. The externalization of cognitive maps by children and adults: In search of ways to ask better questions. In L. Liben, A. Patterson, & N. Newcombe (Eds.) Spatial Representation and behavior across the lifespan. New York: Academic Press, 1981.

Siegel, A., Kirasic, C. & Kail, R. Stalking the elusive cognitive map: The development of children's representations of geographic space. In J. Wohwill & I. Altman (Eds.) Human behavior and environment: Children and the environment (Vol. 3). New York: Plenum, 1983.

Siegel, A., Herman, J., Allen, G. & Kirasic, C. The development of cognitive maps of large- and small-scale spaces. Child Development, 1979, 50, 582-585.

Siegel, A., & White, S. The development of spatial representation of large-scale environments. In H. Reese (Ed.) Advances in child development and behavior (Vol. 10). New York: Academic Press, 1975.

Thorndyke, P. & Hayes-Roth, B. The use of schemata in the acquisition and transfer of knowledge. Cognitive Psychology, 1979, 11, 82-106.

Wellman, H. & Somerville, S. The development of human search ability. In M. Lamb & A. Brown (Eds) Advances in Developmental Psychology, Vol. 2, Hillsdale, NJ: Erlbaum, in press.

Werner, H. & Kaplan, B. Symbol formation. New York: Wiley, 1963.

OVERALL EFFECTS OF QUESTION TYPE ON RELATIVE TASK DIFFICULTY

Problem Type:	QUESTION TYPE		
	APPEARANCE	ITEM	POSITION
ARRAY-ROTATION	EASY	HARDER	EASY
(egocentric)	(NO)	(NO)	(NO)
VIEWER-ROTATION	VERY HARD	EASY	HARDER
(egocentric)	(YES)	(NO)	(YES)

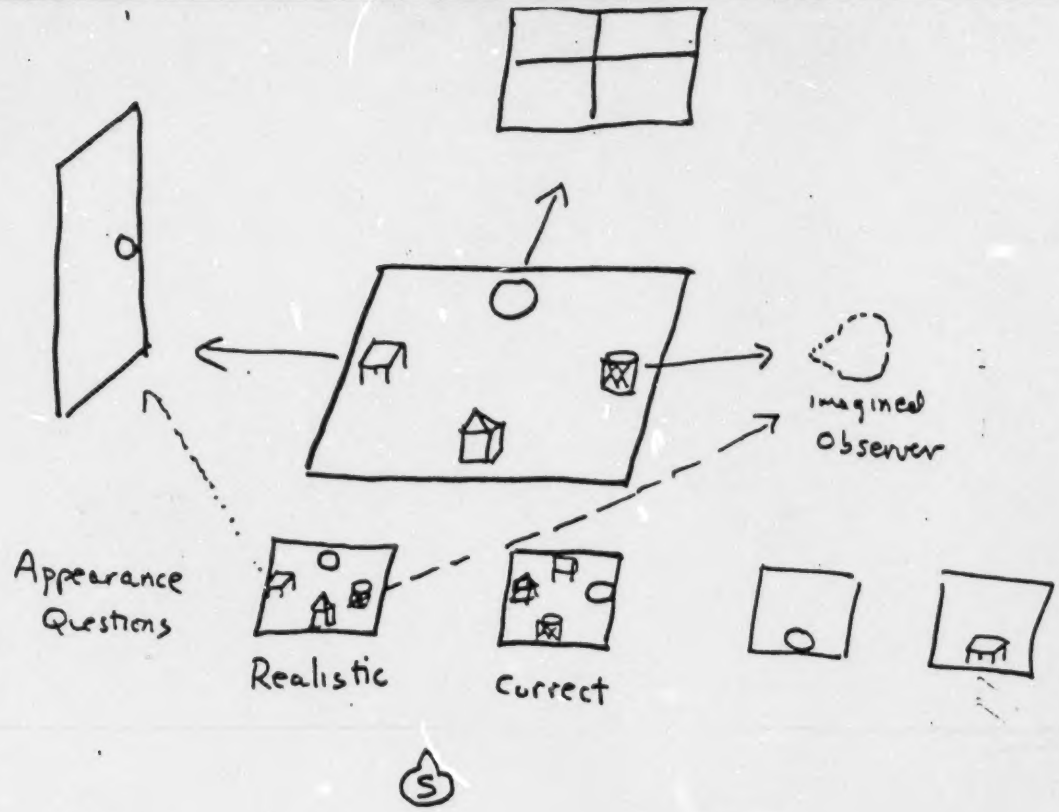
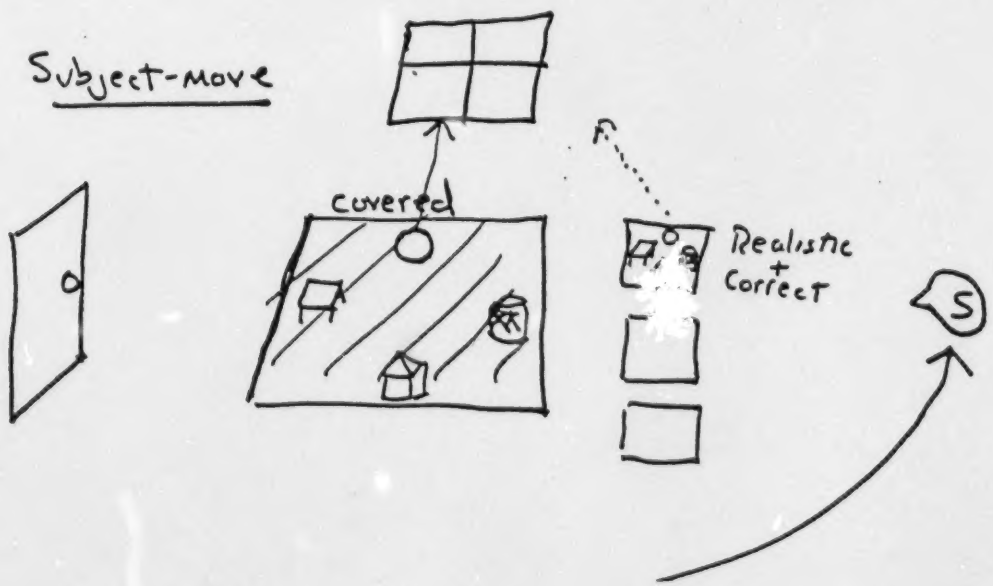


Figure 2. (a) Realistic 'error' with standard appearance question maintaining the relation of the array elements to the immediate spatial field.



(b) When subject moves (relative to covered array), there correct response is realistically aligned with the immediate spatial field and the task is easy (Shantz & Watson, 1970) without a preponderance of egocentric errors (Huttenlocher & Presson, 1973).

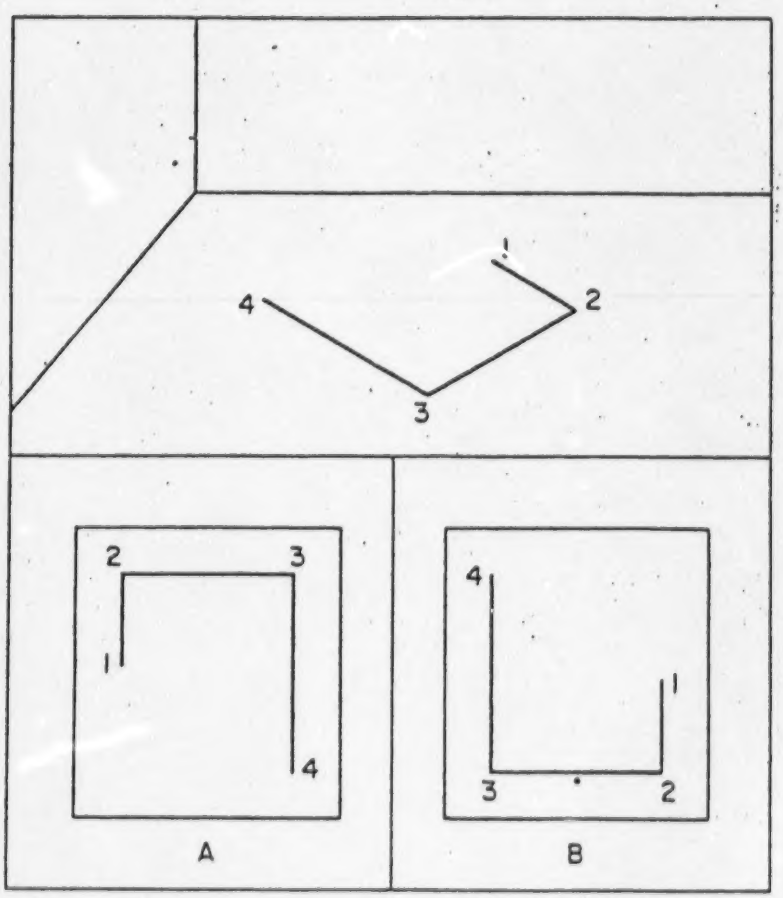


Figure 3. (Top) a four-point path laid out on the floor and (bottom) two maps of that path. (From Levine, 1981)

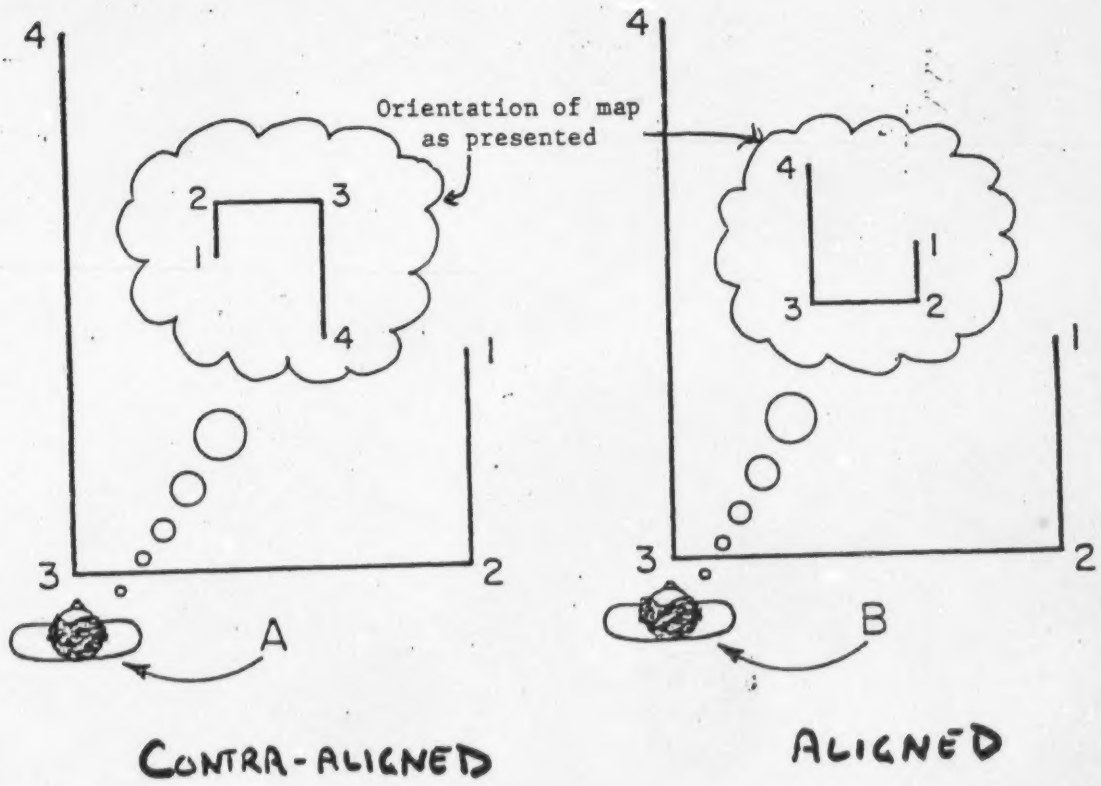


Figure 4. Two subjects making the same judgment (point to location 1 from location 3, facing 4). Subject B should find this task easier than subject A, since the judgment is aligned with the map presentation. (From Levine, 1981)

Condition	Trial Type: ALIGNED	Trial Type: CONTRA-ALIGNED
MAP	18° (0)	56° (27)
LOOK	36° (12)	40° (16)

MEAN ERROR IN DEGREES

(percent of trials with absolute error greater than 90°)

Presson & Hazelrigg

(N=12 per group; 4 trials of each type per subject)